A MIOCENE DUGONGID
FROM BAJA CALIFORNIA, MEXICO

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Introduction

Dugongs, commonly referred to as sea cows, are interesting and comparatively little-known aquatic mammals which live today in coastal waters of the Indian Ocean, Red Sea and the southwestern Pacific Ocean. The fossil record reveals, however, that during the Cenozoic Era dugongids lived in many other parts of the world including the eastern Pacific bordering North and Central America. In 1957, fragments of the jaw of an adult dugongid were collected from the Ysidro Formation exposed near La Purisima, a principal community located 180 miles northwest of La Paz near the Pacific Coast of southern Baja California. This discovery marked the fourth dugongid from Cenozoic beds of the Pacific Coast of North and Central America including the second from Baja California. Although the relative ages of the four dugongids is not clearly understood, present evidence suggests that the La Purisima dugongid may be the oldest of the group. The Ysidro marine invertebrate fauna with which the jaw was associated appears to be no younger than the Temblor fauna (middle Miocene) or older than the Vaqueros fauna (early Miocene) of the California megafaunal sequence.

Acknowledgments

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Order Sirenia

Family Dugongidae

Halianassa(?) allisoni, new species

Figures 1 and 2

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Holotype:—Right lower jaw: Horizontal ramus broken off at the mandibular canal foramen, most of symphyseal region missing, M_3 complete, alveoli for M_2, M_1, P_4, and P_3 present, ascending ramus represented by massateric fossa only. *Left lower jaw:* Includes portion of horizontal ramus dorsal to mandibular canal, incomplete M_3, alveolus for M_2 and lingual portion of alveolus for M_1. *Left coronoid process:* fragment with segments of anterior and posterior margins preserved. University of California, Berkeley, Museum of Paleontology No. 47250. The new species is named in honor of its discoverer, Dr. Edwin C. Allison, Department of Geology, San Diego State College, San Diego, California.

*Type Locality:—*Approximately ¾ mile NNE of the town of La Purisima near base of cliff which forms north bank of major stream in the Arroyo Purisima. This site is about 100 yards downstream from end of side road which branches off the main La Purisima-San Ysidro road about 0.4 miles east of La Purisima and ends at stream. Cliff is composed of gently-folded light-gray and yellowish-brown calcareous sandstone and siltstones totaling about 75 feet in thickness. Near the base of this section is a fine grained, gray sandstone bed about 10 feet thick which forms a prominent overhanging ledge about 150 long ranging from 6 to 25 feet above ground level. The dugongid fossils were collected from the basal part of this sandstone about 8 feet above ground level at the east end of the ledgeforming sandstone.

*Formation:—*Ysidro.

*Age:—*Early-middle Miocene.

*Diagnosis:—*Mandible short, deep, heavily built; medial surface of mandible below M_3 slightly concave, lateral surface slightly convex; M_3 distinctly bilophid, two subcircular roots, metaconid and entoconid of nearly equal size as are hypoconid and protoconid, anteromedially-directed process extends from hypoconid into transverse valley, hypoconulid area includes four tightly-packed cusps partially encircling a fifth cusp which adjoins hypolophid, hypoco-
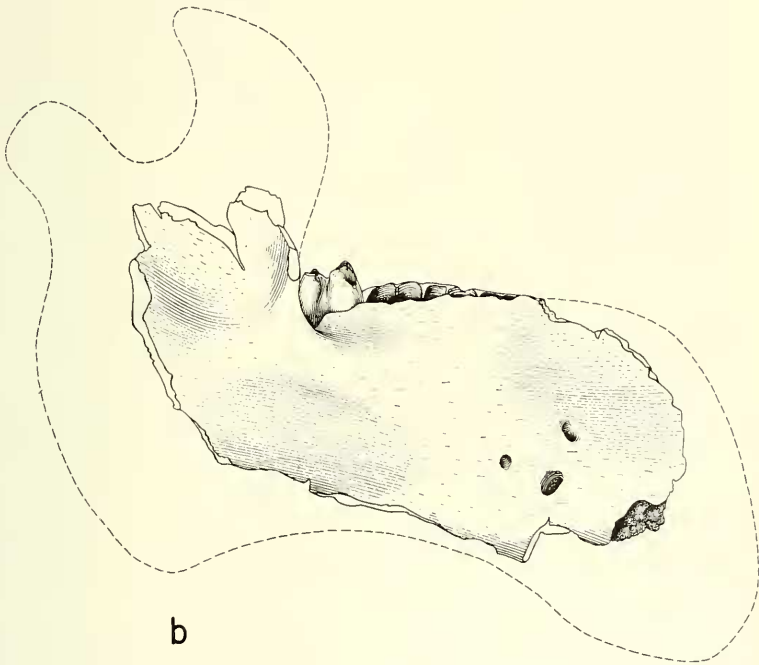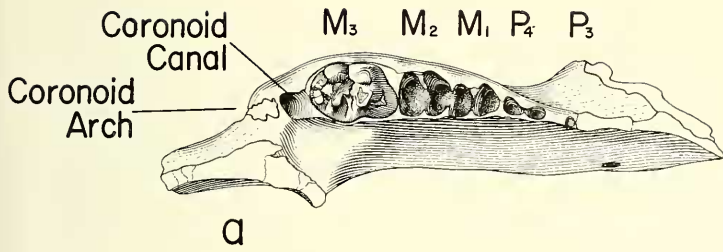
Figure 1. *Halianassa* (?) *allisoni*, new species, UCMP 47250, Ysidro Formation, La Purisima, Baja California, Mexico. a, right mandible, occlusal view; b, right mandible, lateral view.
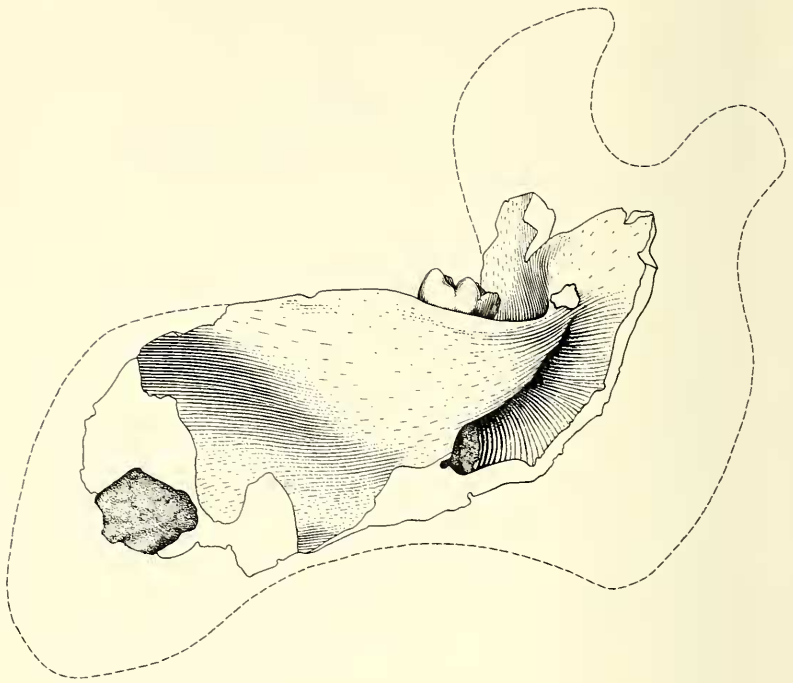
Figure 2. Halianassa (?) *allisoni,* new species, UCMP 47250, Ysidro Formation, La Purisima, Baja California, Mexico. Right mandible, medial view.

nulid area partially concealed from lateral view by anterior margin of ascending ramus; margin of coronoid crest rather thick, rounded and flanged laterally.

Mandible. The horizontal ramus resembles *Dugong* with respect to size and shape but is more stoutly constructed. The ventral margin is not well preserved but the curvature of laminated bone in this region suggests a broader ventral arch in the horizontal ramus than in *Dugong.* The anterior lateral surface is curved outward less strongly than *Dugong* but the posterior curvature of the symphysis is like *Dugong* and the manatee *Trichechus.* The downward deflection of the symphysis is comparable to *Dugong.* The medial and lateral surfaces below M_2 alveolus are slightly concave and convex, respectively. A large, shallow depression, broken off ventrally, is present on the posterior lateral surface of the horizontal ramus ex-

tending from the area below the coronoid crest anteriorly to a location ventral to M_2 alveolus.

The mandibular canal is large and elliptical in cross section with the long axis vertical. It increases in area anteriorly and opposite the symphysis is deflected moderately downward. Three small mental foramina, spaced as on the corners of a right triangle are located on the anterolateral surface, posterior to the mandibular foramen, and appear to lead directly into the mandibular canal.

The masseteric fossa forms a slightly deeper depression than in *Dugong* and possesses faint grooves and pits which may be attaching points of the masseter muscle. The preserved basal part of the coronoid crest is vertical, thick (5mm.) and rounded. It is turned out sharply in an anterolateral direction. The coronoid crest is joined to the horizontal ramus by a strongly-developed curved ridge which merges with the ramus below M_3.

The medial wall of the ascending ramus, opposite the masseteric fossa, consists of an anterior vertical surface which faces anteromedially from a position posterolateral to M_3 and a posterior vertical surface which faces posteromedially. These two vertical surfaces intersect to form a prominent, vertical ridge which is joined to the medial margin of the alveolar row by a small arch.

The coronoid process is represented by a fragment which closely resembles the lower part of the coronoid process in *Dugong*. The anterior and posterior margins are thick and rounded but the anterior one is sharper and is flanged strongly outward.

The tooth row is complete including M_3 and anterior alveoli sufficient for M_2, M_1, P_4 and P_3. The alveolar borders converge anteriorly from a maximum width at M_3 until they join to form a narrow diastem. In profile, the dorsal alveolar margins arch slightly upward. The medial alveolar borders are higher than the lateral borders especially opposite M_3. The sockets for M_2 and M_1 indicate double-rooted teeth with roots located anteriorly and posteriorly. In M_2 the alveoli for the anterior and posterior roots appear to slant steeply anteriorly and posteriorly whereas the root alveoli in M_1 are essentially vertical. The M_2 socket indicates a subquadrate tooth about $\frac{2}{3}$ the occlusal area of M_3 while the M_1 socket suggests a similar outline about one-half the occlusal area of M_3.

Anterior to M_1 are two small alveoli for P_4. The size of the alveoli indicate a tooth of essentially the same length as M_1 but only about one-third the width. A small circular pit, interpreted as the alveolus for a single-rooted P_3, lies anterior to P_4 within the narrow diastem.

Posterior to M_3 the dental groove narrows sharply and is roofed by a small arch of bone which connects the ascending ramus and the medial margin of the tooth row. Similar arches are found in *Dugong*, *Trichechus* and in many other mammals. In *Trichechus* the archway is large enough for the forward passage of cheek teeth which apparently are produced in a single dental capsule located posterior and ventral to the archway. In *Dugong*, and in the specimen from La Purisima, the archway is much too small to allow passage of teeth and may served in these forms only as a strengthening feature between the horizontal and ascending rami. The arch and archway are designated herein as the *coronoid arch* and *coronoid canal*, respectively (Fig. 1).

M_3 in the right mandible is complete and only slightly worn. It is of moderate size, subquadrate in outline and may be regarded as a bilophid-bunodont tooth with well-developed protoconid, hypoconid, entoconid and metaconid cusps and hypoconulid area. The roots are two in number and subcircular. The enamel extends only slightly below the alveolar border. Both protolophid and hypolophid are distinct, transverse ridges. The protoconid and hypoconid are transversely elongate prominences of comparable size and shape. The protoconid is the most heavily worn cusp and is represented by a triangularly-shaped, near-flat surface composed of an outer layer of grayish-brown enamel and an inner area of yellowish-brown dentine. The enamel of the hypoconid has been slightly worn on the anterior side of the cuspid so that a small ovate surface has been formed which declines anteriorly. Near the center of the tooth a spur from the hypoconid curves anteromedially down over the anterior surface of the hypolophid and partially obstructs the transverse valley. A very low ridge follows the bottom of the transverse valley extending from the base of the spur to the lateral margin of the tooth. The metaconid and entoconid are semi-circular cusps similar to each other in size and shape and are about one-third the size of the protoconid and hypoconid by shallow notches located about one-third the distance from the medial to the lateral margins of the lophs. The metaconid and entoconid are worn slightly and the surfaces of wear decline posterolaterally.

The hypoconulid area is lower than the hypolophid and is composed of four, closely-compressed cusps which form the semi-circular posterior margin of the tooth. Another cusp is centrally located and obstructs the posterior valley formed between the four posterior cusps and the hypolophid. No cingulum is present but a small V-

shaped, indentation is located on the anterolateral surface of the tooth about halfway between the crest of the protoconid and the base of the enamel.

In the fragment of the left mandible, a large, bowl-shaped pit lies immediately posterior to M_3 and ventral to the coronoid arch. This pit appears to be the remains of a tooth capsule but no dental materials are now evident. The significance of this structure is not clear but it may represent an aberrant development of a fourth molar. No similar structure is present in the right mandible and the corresponding region is somewhat smaller and composed of dense bone.

Most of the mandible is composed of dense, laminated bone except near the posterior margin of the ascending ramus. The relatively high proportion of dense bone suggests that the jaw represents an adult individual.

Comparisons

Recent Sirenia

The mandible is similar to that of *Dugong* with respect to shape and length but is more heavily constructed. The deflection angle of the partially-preserved symphysis in *Halianassa* (?) *allisoni* appears nearly equivalent to *Dugong*. The double-rooted, bilophodont M_3 of *H*. (?) *allisoni* differs sharply from the corresponding, small, cylindrical teeth in *Dugong* which possess very small, pointed cuspules arranged in anterior and posterior clumps. Tome (1914) considers the teeth in *Dugong* to be of semi-persistent growth and degenerating. Such degeneration explains the gross dissimilarity between teeth of *Dugong* and *H*. (?) *allisoni*.

The mandible of the extinct Recent genus, *Hydrodamalis*, is about four times larger than that of *H*. (?) *allisoni*, lacks teeth altogether and the ventral margin of the horizontal ramus is nearly straight and more like that found in the Trichechidae. The medial side of the edentulous dorsal ridge sharply overhangs the medial region, a character only faintly represented in *H*. (?) *allisoni*.

The mandible of *Trichechus* possesses a relatively long, slender horizontal ramus which differs sharply from the deeper and more strongly-built, horizontal ramus of *H*. (?) *allisoni*. The M_3 of *H*. (?) *allisoni* is somewhat similar to the smaller homodont, bilophid teeth of *Trichechus* differing principally in being about four times larger, lacking a cingulum and in that the hypoconulid area is relatively lower. Aside from these differences the cheek teeth of *Trichechus* are somewhat comparable to M_3 of *H*. (?) *allisoni* with respect to the

arrangement, shape and relative sizes of the cusps and the obstructed transverse valley. The general resemblance of teeth representing the Trichechidae and Dugongidae may be the result of similar adaptations to environment.

Cenozoic Dugongidae from the Pacific Coast of North America

Halianassa vanderhoofi is from beds assigned to the Santa Margarita Formation near Santa Cruz, California. VanderHoof (1941) and Reinhart (1959) regard this species as of Tortonian age (early late Miocene) based on a comparison with European dugongids. Mitchell and Repenning (1963) indicate that marine invertebrate fossils found in the same Santa Margarita beds are "suggestive of a very late Miocene age (Neroly Stage)." *H. vanderhoofi* consists of a skull, mandible and post-cranial elements. The jaw is approximately 1.75 times larger than that of *H.* (?) *allisoni*. The medial margin of the alveolar wall markedly overhangs the medial region reminiscent of *Hydrodamalis* but much more pronounced than in *H.* (?) *allisoni*. The protolophid is lost in M_3 of *H. vanderhoofi*. The hypolophid measures 22.50mm. in width compared to 19.8mm. in *H.* (?) *allisoni* and is composed of relatively loosely-packed cuspules which do not coalesce to form a distinct transverse loph as in the La Purisima specimen. The hypoconulid area is composed of 3 cuspules separated from the entoconid and hypoconid by a hexagonal lake while in *H.* (?) *allisoni* there are four, tightly-packed cuspules partially encircling a fifth which adjoins the hypolophid. No anteriorly-directed process extends from the hypoconid into the transverse valley in M_3 of *H. vanderhoofi* as it does in *H.* (?) *allisoni*. There is no evidence of P_3 in *H. vanderhoofi* although it appears to have been present in *H.* (?) *allisoni*. The coronoid crest is not sharply turned out or rounded and in this respect *H. vanderhoofi* is similar to *Halianassa* sp. indet. from Punta Pequena, southern Baja California (Reinhart, 1959).

The skull of *Halianassa* (=*Metaxytherium*) *jordani* was described by Kellogg (1928) from diatomaceous deposits near Lompoc, California which have been mapped as the Sisquoc Formation by Dibblee (1950). Kellogg regarded the sirenian to be "Sarmatian, or Upper Miocene" in age although it was apparently collected from a Sisquoc horizon which may be early Pliocene or even middle Pliocene in age according to Dibblee. The skull is virtually the same size as *H. vanderhoofi* and differs from the latter species only in minor differences in the sizes of the frontals and parietals. Reinhart

(1959) interprets *H. vanderhoofi* and *H.* (=*Metaxytherium*) *jordani* as being closely related species. Although no mandibular elements were apparently recovered with the skull of *H.* (=*Metaxytherium*) *jordani* the size of the mandible would be expected to be nearly equal to that of *H. vanderhoofi* and considerably larger than the adult mandible of *H.* (?) *allisoni*.

Cenozoic Dugongidae from the Pacific Coast of Central America

Halianassa sp. indet. from the Ysidro Formation at Punta Pequena, Baja California includes cranial and post-cranial elements and a mandible which are interpreted by Reinhart (1959) as those of an adolescent individual. The mandible lacks the tooth row dorsal to the mandibular canal but otherwise is complete. It is of nearly the same length as the adult mandible of *H.* (?) *allisoni* but due to its youthful stage is much more delicately formed. The ascending ramus is remarkably similar to that of *H. vanderhoofi* with respect to outline and the relative sizes and positions of the masseteric fossa and the two large fossae of the medial surface. The ventral margin of the horizontal ramus appears to be more strongly arched than in *H.* (?) *allisoni*. The coronoid crest of *Halianassa* sp. indet. is directed in an anterior-posterior direction unlike that of *H.* (?) *allisoni* which is sharply turned out laterally. Along the dorsal medial edge of the symphysis there is an elongate fossa which is not apparent in *H.* (?) *allisoni*. Cranial elements of the adolescent *Halianassa* sp. indet. are nearly as large as corresponding bones in adult *Felsinotherium serresi* from France and somewhat larger than those of a mature *Dugong*. Reinhart (1959) considers that *Halianassa* sp. indet. in the adult stage would be large and referable to either *H. vanderhoofi* or *H.* (=*Metaxytherium*) *jordani*. In any case, *Halianassa* sp. indet. when fully grown would be expected to be considerably larger than an adult *H.* (?) *allisoni*.

Cenozoic Dugongidae from the Atlantic Coast of North America

Dugongid fossils, mainly skull and post-cranial elements, are known from Cenozoic deposits in Maryland, South Carolina, New Jersey and Virginia. Many of the fossils are fragmentary and of doubtful provenance. No mandibles have been reported and only one lower tooth has been described. This tooth was recovered from the Ashley Creek beds, South Carolina, and described by Leidy (1873) under the name *Manatus inornatus*. It is a small, rectangular, molar(?) with well-developed bicuspid lophs and a simple hypoconulid

area. The tooth is distinct from M_3 of *H.* (?) *allisoni* because of its much smaller size and less complex hypoconulid area. The occlusal outline appears to be more elongate than would be expected for either M_2 or M_1 of the La Purisima specimen. Simpson (1932) considers this tooth to be generically indeterminate.

Cenozoic Dugongidae from Florida

Although numerous dugongid remains have been collected from Cenozoic deposits in Florida no mandibles have been reported and only a single, lower tooth has been described. Hay (1922) provisionally referred a tooth, believed to be the right hindermost molar (M_3) of a sea cow, to *Metaxytherium floridanum*. This tooth is nearly identical in occlusal outline and dimensions to that of M_3 of *H.* (?) *allisoni* but is heavily worn and few details of the cusp morphology are evident. It was collected as beach drift in Manatee County, Florida associated with mammal and fish debris believed by Hay to have been derived from Miocene, Pliocene and Pleistocene beds of the region. This tooth is of doubtful value in a comparison to M_3 of *H.* (?) *allisoni* although it may represent a similar stage of evolution.

Hesperosiren crategensis Simpson (1932) from the Hawthorn Formation (Miocene) is based upon a skull and post-cranial elements. The length of the upper tooth row is nearly identical to the lower tooth row in *H.* (?) *allisoni* but the rostral deflection as reconstructed by Simpson is considerably less than that which would be expected to accommodate the mandible of *H.* (?) *allisoni*. Simpson (1932) suggests that *H. craetegensis* is close in actual affinity to *Metaxytherium* but is slightly more aberrant in specialization.

Cenozoic Dugongidae from the Caribbean region

Caribosiren turneri was recovered from the San Sebastian Formation (Oligocene) of Puerto Rico and consists of a skull and post-cranial elements (Reinhart. 1959). The rostral deflection of the skull corresponds roughly to the deflection angle of the preserved symphyseal region in *H.* (?) *allisoni*. The upper tooth row in *C. turneri* is slightly shorter than that of the lower jaw of *H.* (?) *allisoni* but it includes an equivalent number of molars (M_1, M_2 and M_3) and premolars (P_3 and P_4). These similarities suggest that *C. turneri* represents a stage of evolution near to that of *H.* (?) *allisoni*. Reinhart (1959) considers *C. turneri* to be assignable to the Haliannasidae.

(?) *Halitherium antillense*, described by Matthew (1915) from middle Oligocene(?) shales near Juana Diaz, Puerto Rico, is based upon a left, lower jaw with M_1, M_2 and M_3 preserved. The alveoli anterior to M_1 are interpreted by Matthew as representing three premolars, a condition more primitive than that found in *H*. (?) *allisoni*. The shape of the posterior part of the jaw is suggestive of *Halitherium* but the molars are heavily worn and damaged and reveal few details of comparative value. Matthew considered the Puerto Rican jaw to be that of a halithere possessing characters reminiscent of two European species, *Halitherium schinzi* (Oligocene) and *Halitherium christoli* (lower Miocene).

Cenozoic Dugongidae of Europe

Of the European dugongids, *H*. (?) *allisoni* appears nearest to *Metaxytherium cuvieri* de Christol from the middle Miocene (Vindobonian) of France. The length of the mandible is essentially the same and the shape is similar except that the ventral arch of the horizontal ramus appears more sharply rounded in the French species. The number of molars is the same as in *H*. (?) *allisoni* but only a single premolar (P_4) compared to two premolars (P_3 and P_4) for the Mexican species. The right M_3 of *M. cuvieri* is a bunobilophodont tooth of virtually the same size as M_3 in *H*. (?) *allisoni* and the cusps are comparable with respect to size and position. Although the figure of this tooth in Deperet and Roman (1920) is not clear, a narrow spur appears to extend from the hypoconid anteromedially into the transverse valley as in *H*. (?) *allisoni*. In *M. cuvieri*, however, all the remaining cheek teeth are larger than those which would be expected to occupy the corresponding alveoli in *H*. (?) *allisoni*. In fact, M_2 is longer than M_3 in *M. cuvieri* whereas in *H*. (?) *allisoni* the M_2 alveoli indicate a smaller tooth than M_3. The mandibular foramen in *M. cuvieri* occupies a somewhat different position as that in *H*. (?) *allisoni* being located directly below P_4 while in the La Purisima jaw it is below the anteriormost part of the diastem.

The mandible of *Felsinotherium serresi* Deperet and Roman (1920) from the Pliocene of France closely resembles *H*. (?) *allisoni* although it is slightly smaller and possesses a more strongly produced ventral arch of the horizontal ramus. The right M_3 figured by Deperet and Roman (1920) is a bilophodont tooth similar in size, occlusal outline and cusp pattern. A cluster of small cuspules between the entoconid and hypoconid obstructs the transverse valley in M_3 of *F. serresi* differing from M_3 in *H*. (?) *allisoni* in which

the transverse valley is partially obstructed by a narrow spur. The cheek teeth include three molars (M_1, M_2 and M_3) and a single premolar (P_4) with no evidence of P_3 having been present. P_4 appears to be proportionately much more reduced than in *H*. (?) *allisoni*.

In *Thallatosiren petersi* from the middle Miocene (Vindobonian) of Austria, the M_3 (M_4 in Abel, 1904) is a subrectangular to oval-shaped tooth sharply constricted the transverse valley. Between the protoconid and metaconid and also between the hypoconid and entoconid are clumps of from two to three additional cusps which do not occur in *H*. (?) *allisoni*.

The mandible of *Felsinotherium forestii* from the Pliocene of Italy (Capellini, 1872) is larger than that of *H*. (?) *allisoni* and possesses a more sharply rounded ventral arch of the horizontal ramus. The rectangular M_3 is larger and the bilophodonty less distinctly developed. The anterior part of the tooth consists of a single, moderately worn prominence while the posterior two-thirds is composed of a series of irregularly arranged cusps, a condition not found in *H*. (?) *allisoni*.

The M_3 of *Felsinotherium gervasi* from the Pliocene of Italy (Bruno, 1839) differs sharply from M_3 of *H*. (?) *allisoni* in that the anterior and posterior lophs are composed of nine and seven cusps, respectively, compared to bicuspate lophs in the Mexican species. The hypoconulid area of *F. gervasi* is more complex and more strongly produced than in *H*. (?) *allisoni*.

The mandible of *Halitherium schinzi* from the Oligocene of France (Lepsius, 1882) is similar in length to that of *H*. (?) *allisoni* but is much slenderer and less strongly constructed. The larger number of teeth in *H. schinzi* is decidedly more primitive than the condition in *H*. (?) *allisoni*, the former possessing seven cheek teeth compared to five for the latter. The right posterior molar (M_4 according to Lepsius, 1882) is slightly larger than M_3 of *H*. (?) *allisoni*. It consists of seven, large, cone-shaped cusps located along the margins of the tooth which produce a winding, longitudinal valley. This condition is sharply different from the well-developed transverse lophs and valley of *H*. (?) *allisoni*.

The mandible of *Halitherium christoli* from the lower Miocene of Austria (Abel, 1904) is slightly larger than that of *H. schinzi* but is of similar shape. M_3 of *H. christoli* differs from M_3 of *H*. (?) *allisoni* in that the occlusal outline is more oval and the transverse valley is sharply bent, a condition not found in the Mexican species.

The left posterior molar (M_4 of Abel, 1904) of *Metaxytherium*

krahuletzi from the early Miocene (Burdigalian) is a bilophid, sub-quadrate tooth slightly larger than M_3 of *H.* (?) *allisoni*. The anterior loph is nearly twice the width of the posterior loph. The disproportion in loph width is not found in the La Purisima specimen in which the lophs have essentially the same width.

Other European species including *Miosiren kocki*, *Metaxytherium beaumonti* and *Halitherium bellunense* do not appear sufficiently comparable to *H.* (?) *allisoni* to warrant comment here.

Affinities

The classifications of the Sirenia proposed by Simpson (1934; 1945) and by Reinhart (1959) are based upon cranial and post-cranial elements. Because of this circumstance the isolated mandible of *H.* (?) *allisoni*, while that of an adult dugongid, cannot be referred to any of the established genera except on a questionable basis. The relatively short, deep horizontal ramus and well-developed, buno-bilophodont M_3 with partially obstructed transverse valley stamp the La Purisima jaw as decidedly closer to *Halianassa* (=*Metaxytherium*) and *Felsinotherium* than to *Halitherium* or any other Cenozoic genus. That all previous dugongid remains recovered from Cenozoic deposits of the Pacific Coast of North and Central America have also been assigned to either *Halianassa* or its synonym *Metaxytherium* lends additional although by no means conclusive support to the present referral to *Halianassa*. The difficulty of satisfactorily separating *Halianassa* and *Felsinotherium* is well known. Capellini (1872) considered the two genera synonymous and Simpson (1934) and Gregory (1941) both have pointed out that the differences proposed to separate these genera are rather slight and inconstant.

On the basis of current evidence of Old and New World dugongids, *H.* (?) *allisoni* appears morphologically nearest to *Metaxytherium cuvieri* from France. The rather marked similarity existing between M_3 of *M. cuvieri*, *F. serresi*, and *H.* (?) *allisoni* suggests that these species may represent a particular line of dugongid development. *H. vanderhoofi* differs significantly from *H.* (?) *allisoni* and seems unlikely to be on the main line of descent from the latter species. The phyletic relationship between the juvenile *Halianassa* sp. indet. from Punta Pequena, Baja California, and the adult *H.* (?) *allisoni* is uncertain. In the adult stage, Reinhart (1959) suggests that *Halianassa* sp. indet. would be expected to grow to a large size and would be referable to either *H. vanderhoofi* or *H. jordani*. It may,

therefore, be considered to express a more advanced stage of evolution than *H.* (?) *allisoni*.

The present evidence of dugongid mandibles or lower dentition from Cenozoic deposits of the Atlanti Coast of North America, Florida and the Caribbean region is exceedingly meagre and any inferences concerning phyletic relationship between species of these regions and *H.* (?) *allisoni* must be highly speculative. It is unfortunate that neither *Hesperosiren craetegensis* from the Miocene of Florida nor *Caribosiren turneri* from the Oligocene of Puerto Rico, near contemporaries of *H.* (?) *allisoni*, are represented by mandibles or lower dentition. It is possible that one or the other of these species may ultimately by found to be closely related to *H.* (?) *allisoni*.

Age of Halianassa (?) allisoni

The Ysidro Formation, from which the jaw of *H.* (?) *allisoni* was collected, was named by Heim (1922) for clastic sedimentary rocks exposed 2 miles N.E. of La Purisima near the village of San Ysidro. Beal (Anon., 1924; 1948) later extended the usage of the Ysidro Formation recognizing it throughout much of southern Baja California. The Ysidro fauna includes abundant, shallow water, marine mollusks and echinoderms associated with shark teeth, dugongid remains and numerous indeterminate mammal bones. Such molluscan genera as *Lyropecten, Codakia,* and *Strombus* associated with *Turritella, Cypraea, Terebra* and *Chione* point to subtropical marine conditions.

The Ysidro marine invertebrate fauna has been studied by a number of competent paleontologists. Hertlein and Jordan (1927) interpreted collections from the Ysidro at La Purisima, San Ignacio, the Western Cape region and near La Paz as equivalent at least in part to the lower part of the Temblor fauna of California (early to middle Miocene). Loel and Corey (1932) compared a collection of 64 invertebrates, mostly mollusks, from the Ysidro with those of the Temblor and Vaqueros. They concluded that the assemblage as a whole favored a correlation with the upper part of the Vaqueros fauna (early Miocene) of California. The Ysidro fauna with which the jaw of *H.* (?) *allisoni* was associated would appear, on the basis of these opinions, to be not younger than the Temblor (middle Miocene) or older than the Vaqueros (early Miocene) of the California megafaunal sequence (Weaver, 1944). However, until the fauna and biostratigraphy of the Ysidro is more completely known the

present interpretation of age for *H.* (?) *allisoni* should be considered as tentative.

Age Relationships with Dugongids from the Pacific Coast

If the preceding correlation of the Ysidro fauna with the Temblor-Vaqueros faunas is correct, then *H.* (?) *allisoni* is older than either *H. vanderhoofi* from the Santa Margarita beds (late Miocene), Santa Cruz County, California or *H.* (=*Metaxytherium*) *jordani* from the Sisquoc Formation (late Miocene-early Pliocene), Santa Barbara County, California. The Santa Margarita and Sisquoc beds are in part equivalent in age but their faunas have been strongly established as younger than those from either the Temblor or Vaqueros formations (Weaver, 1949).

Halianassa sp. indet. was discovered at Punta Pequena located on the Pacific Coast of southern Baja California about 27 miles west of La Purisima. Both *H.* (?) *allisoni* and *Halianassa* sp. indet. were collected from beds mapped as the Ysidro sandstone member of the Ysidro Formation by Beal (1948). This unit was later renamed San Raymundo Formation by Mina (1957). Neither the work of Beal or Mina is, however, sufficiently detailed as to permit the determination of a precise or even approximate stratigraphic relationship between the two dugongid sites.

The marine invertebrate fossils found with *Halianassa* sp. indet. are far too meagre and poorly preserved to be useful in relating the two dugongid sites. According to Reinhart (1959) three molluscan genera were recognized including *Lucina, Chione,* and *Turritella* but none of these were identifiable to species. Fragments of a small, scutellid echinoid like *Merriamaster pacificus* were also found. *M. pacificus* is regarded as a Pliocene species by Grant and Hertlein (1938) and has been found in the San Diego and Saugus formations and Pliocene beds on Cedros Island. However, until better fossils can be collected from the Punta Pequena beds no meaningful age interpretation can be made for *Halianassa* sp. indet.

The dugongid remains themselves, the adult *H.* (?) *allisoni* and the juvenile *Halianassa* sp. indet., also do not offer a promising basis for interpretation of relative age. If Reinhart (1959) has correctly interpreted that the juvenile jaw of *Halianassa* sp. indet. in the adult stage would be of a size comparable to either *H. vanderhoofi* or *H. jordani* it may be tentatively concluded that the Punta Pequena species represents a more advanced stage of evolution than *H.* (?) *allisoni* and is, therefore, younger in age. Reinhart (1959) considers

Halianassa sp. indet. as representing a middle to upper Miocene stage of evolution. All that can be stated at present is that *Halianassa* sp. indet. is probably not older than *H.* (?) *allisoni* and there are some indications that it is younger.

CONCLUSIONS

1. The lower jaw from La Purisima is that of an adult dugongid questionably referred to the genus *Halianassa*.

2. The dugongid appears to be a new species and is herein designated *Halianassa* (?) *allisoni*.

3. *Halianassa* (?) *allisoni* is older than either *H.* (=*Metaxytherium*) *jordani* or *H. vanderhoofi* from California.

4. *H.* (?) *allisoni* is probably not younger than *Halianassa* sp. indet. from Punta Pequena. southern Baja California and there are some indications that it is older.

5. *H.* (?) *allisoni* and the associated Ysidro marine invertebrate fauna are considered to be no younger than the Temblor fauna (middle Miocene) or older than the Vaqueros fauna (early Miocene) of the California megafaunal sequence.

6. *H.* (?) *allisoni* is closer phyletically to *Metaxytherium cuvieri* and *Felsinotherium serresi* from Europe than to any known species from the Western Hemisphere.

TABLE OF DIMENSIONS (mm)
Mandible

Maximum length of fragment	195.0
(Broken posterior edge of ascending ramus to broken anterior edge of symphysis)	
Maximum height of fragment	122.0
(Broken dorsal edge of ascending ramus to ventral edge of symphysis)	
Maximum width of fragment	50.0
(Coronoid crest to medial wall of horizontal ramus)	
Thickness of horizontal ramus	35.0
(Below M_3)	

Lower Dentition

Length of tooth row	87.0
(Anterior edge of P_3 alveolus to posterior surface of M_3)	
Anterior-posterior diameter:	
M_3	26.5

M₂	2 alveoli	17.0
M₁	2 alveoli	15.0
P₄	2 alveoli	14.0
P₃	alveolus	2.5

Transverse diameter:

M₃	maximum across hypoconid-metaconid	19.8
	minimum across protoconid-entoconid	18.3
M₂	both alveoli	15.0
M₁	anterior alveolus	10.0
	posterior alveolus	11.0
P₄	anterior alveolus	4.0
	posterior alveolus	5.0
P₃	alveolus	2.5

Crown height above alveolus:

M₃	labial	14.0
M₃	lingual	10.0

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